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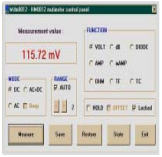
4¾-Digit programmable Multimeter HM8012

WDM8012 Software (incl. delivery)



HZ15
PVC Test Leads

Mainframe
HM8001-2

- 4¾ digit display with 50,000 counts
- Basic accuracy 0.05%
- Automatic and manual range selection
- Max. resolution 10µV, 0.01dBm, 10nA, 10mΩ, 0.1°C/°F
- Offset function/relative value measurement in basicmeasurement functions
- Input impedance >1GΩ (0.5V and 5V DC range)
- RS-232 interface
- PC software for control and data logging
- Mainframe HM8001-2 required for operation

SPECIFICATIONS

valid at 23 deg. C after a 30 minute warm-up period

DC voltages

Measurement ranges:	500 mV, 5V, 50V, 500V, 600V
Resolution:	10 µV, 100 µV, 1 mV, 10 mV, 100 mV
Accuracy:	
5V, 500V, 600V:	±(0.05% of rdg.[1] +0.002% of fs.[2])
500 mV, 50V:	± (0.05% of rdg.[1] + 0.004% of fs.[2])
Overload protection:	
V/Ω/T°/dB/⊣◄ against COM and to chassis:	
	850 V_p at max.60 Hz or 600 V_{DC}
Low against chassis:	250 V_{rms} at max. 60 Hz or 250 V_{DC}
Input resistance:	
50V, 500V, 600V:	10 MΩ II 90 pF
500 mV, 5V:	>1 GΩ II 90 pF
Input current:	10 A
CMRR[3]:	≥100 dB (50/60 Hz ± 0.5%)
SMRR[4]	≥ 60 dB (50/60 Hz ± 0.5%)

dB Mode

Accuracy:	±(0,02 dB + 2 digits) (display > –38,7 dBm)
Resolution:	0.01 dB above 18% of fs.[2]

DC current

Measurement ranges:	500 µA, 5 mA, 50 mA, 500 mA, 10 A
Resolution:	10 nA, 100 nA, 1 µA, 10 µA, 1 mA
Accuracy:	
0,5 – 500 mA:	±(0.2% of rdg.[1] + 0.004% of fs.[2]),
10 A:	±(0.3% of rdg.[1] + 0.004% of fs.[2])
Voltage drop:	
10 A range:	0.2 V max.
500 mA range:	2.5 V max.
other ranges:	0.7 V max.

AC voltage

Measurement ranges:	500 mV, 5V, 50V, 500V, 600V
Resolution:	10 µV, 100 µV, 1 mV, 10 mV, 100 mV
Accuracy 0,5-50V:	
40 Hz - 5 kHz:	± (0.4% of rdg.[1] + 0.07% of fs.[2])
20 Hz - 20 kHz:	± (1% of rdg.[1] + 0.07% of fs.[2])
500V and 600V:	
40 Hz - 1 kHz:	± (0.4% of rdg.[1] + 0.07% of fs.[2])
20 Hz - 1 kHz:	± (1% of rdg.[1] + 0.07% of fs.[2])
Overload protection:	
V/Ω/T°/dB/⊣◄ against COM and to chassis:	
	850 V_s at max.60 Hz or 600 V_{DC}
Low against chassis:	250 V_{eff} at max. 60 Hz or 250 V_{DC}
Input impedance	**AC mode:** 1 MΩ II 90 pF
	AC + DC mode: 10 MΩ II 90 pF
Bandwidth at -3 dB:	80 kHz typical
dB Mode:	20 Hz - 20 kHz
Accuracy (–23.8 - 59.8 dBm):	±0.2 dBm
Resolution:	0.01 dB above 9 mV
CMRR[3]:	≥ 60 dB (50/60 Hz ± 0.5%)
Crest factor:	7 max.

AC current

Measurement ranges:	500 µA, 5 mA, 50 mA, 500 mA, 10 A
Resolution:	10 nA, 100 nA, 1 µA, 10 µA, 1 mA
Accuracy:	
0.5-500 mA:	±(0.7% of rdg.[1] +0.07% of fs.[2]) for 40Hz-5kHz
10A:	± (1% of rdg.[1] + 0.07% of fs.[2])

AC + DC measurements

Same as AC + 25 Digits

Resistance

Ranges:	500Ω, 5kΩ, 50kΩ, 500kΩ, 5MΩ, 50MΩ
Resolution:	10mΩ, 100mΩ, 1Ω, 10Ω, 100Ω, 1kΩ
Accuracy:	
500 Ω to 500 kΩ:	±(0.05% of rdg.[1]+0.004% of fs.[2]+50mΩ)
5 MΩ and 50 MΩ:	±(0.3% of rdg.[1]+0.004% of fs.[2])
	Input protected to max. 300 V_{eff}
Measurement current	
500 Ω – 5kΩ-range:	1 mA
50kΩ-range:	100 µA
500kΩ-range:	10 µA
5 - 50MΩ-range:	100 nA

Measurement voltage

10V typical for open inputs, depending on the value of resistance to be measured. Negative polarity of measurement voltage is across common terminal.

Temperature

2-wire resistance measurement with linearization for PT100 sensors as per standard EN60751

Range:	–200 °C to +500 °C
Resolution:	0.1°C
Measurement current:	ca. 1 mA
Display:	in °C, °F
Accuracy:	
–200 °C to +200 °C	± 0.4 °C + 0,0005 x T
+200 °C to +500 °C	± 0.5 °C + 0,0005 x T
	(T in °C, sensor tolerance not included)

Temperature coefficient: (Reference 23°C)

V =	500 mV, 50V	30 ppm/°C
	600V range	80 ppm/°C
	other ranges	20 ppm/°C
V ~	600V range	80 ppm/°C
	other ranges	50 ppm/°C
mA	all ranges	200 ppm/°C
mA-	all ranges	300 ppm/°C
Ω	5 MΩ, 50 MΩ-ranges	200 ppm/°C
	other ranges	50 ppm/°C

Miscellaneous

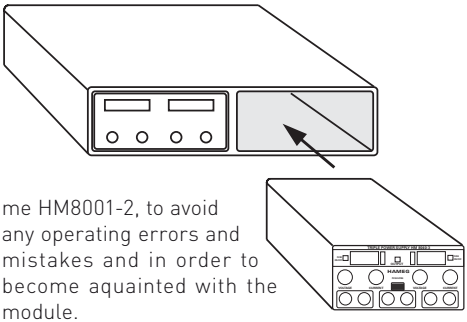
Operating conditions:	+ 10°C to + 40°C
max. rel. humidity:	80% (without condensation)
Power supply (from HM8001-2):	
+ 5 V	300 mA
~26 V	140 mA
Size (W x H x D):	135 x 68 x 228 mm (without flat 22-pole connector)
Weight:	ca. 500g

[1] rdg. = reading;
[2] fs. = full scale;
[3] = Common mode rejection ratio;

Included in delivery: HM8012 Multimeter, Manual, HZ14 Interface cable, HZ15 PVC Test Leads, Software-CD. **Accessories:** HZ10 Silicone Test Leads, HZ812 PT100 Temperature Sensor

Important hints

The operator is requested to carefully read the following instructions and those of the mainframe HM8001-2, to avoid any operating errors and mistakes and in order to become aquainted with the module.



After unpacking the module, check for any mechanical damage or loose parts inside. Should there be any transportation damage, inform the supplier immediately and do not put the module into operation. This plug-in module is primarily intended for use in conjunction with the Mainframe HM8001-2. When incorporating it into other systems, the module should only be operated with the specified supply voltages.

Safety

This instrument has been designed and tested in accordance with IEC Publication 1010-1, Safety requirements for electrical equipment for measurement, control, and laboratory use. It corresponds as well to the the CENELEC regulations EN 61010-1. All case and chassis parts are connected to the safety earth conductor. Corresponding to Safety Class 1 regulations (three-conductor AC power cable). Without an isolating transformer, the instrument's power cable must be plugged into an approved three-contact electrical outlet, which meets International Electrotechnical Commission (IEC) safety standards.

Warning!
Any interruption of the protective conductor inside or outside the instrument or disconnection of the protective earth terminal is likely to render the instrument dangerous. Intentional interruption is prohibited.

The istrument must be disconnected and secured against unintentional operation if there is any suggestion that safe operation is not possible.

This may occur:
- if the instrument shows visible damage,
- if the instrument has loose parts.
- if the instrument does not function,
- after long storage under unfavourable circumstances (e.g. outdoors or in moist environments),
- after excessive transportation stress (e.g. in poor packaging).

When removing or replacing the metal case, the instrument must be completely disconnected from the mains supply. If any measurement or calibration procedures are necessary on the opened-up instrument, these must only be carried out by qualified personnel acquainted with the danger involved.

Symbols marked on equipment

ATTENTION refer to manual.

DANGER High voltage.

Protective ground (earth) terminal.

Operating conditions

The ambient temperature range during operation should be between +10 °C and +40 °C and should not exceed –40 °C or +70 °C during transport or storage. The operational position is optional, however, the ventilation holes on the HM8001-2 and on the plug-in modules must not be obstructed.

Warranty and Repair

HAMEG instruments are subjected to a strict quality control. Prior to leaving the factory, each instrument is burnt-in for 10 hours. By intermittent operation during this period almost all defects are detected. Following the burn-in, each instrument is tested for function and quality, the specifications are checked in all operating modes; the test gear is calibrated to national standards.

The warranty standards applicable are those of the country in which the instrument was sold. Reclamations should be directed to the dealer.

Only valid in EU countries
In order to speed reclamations customers in EU countries may also contact HAMEG directly. Also, after the warranty expired, the HAMEG service will be at your disposal for any repairs.

Return material authorization (RMA):
Prior to returning an instrument to HAMEG ask for a RMA number either by internet (http://www.hameg.com) or fax. If you do not have an original shipping carton, you may obtain one by calling the HAMEG sales dept (+49-6182-800-300) or by sending an email to vertrieb@hameg.com.

Maintenance

The most important characteristics of the instruments should be periodically checked according to the instructions provided in the sections ¨Operational check and ¨Alignment procedcure. To obtain the normal operating temperature, the mainframe with inserted module should be turned on at least 60 minutes before starting the test. The specified alignment procedure should be strictly observed. When removing the case detach mains/line cord and any other connected cables from case of the mainframe HM8001-2. Remove both screws on rear panel and, holding case firmly in place, pull chassis forward out of case. When later replacing the case, care should be taken to ensure that it properly fits under the edges of the front and rear frames. After removal of the two screws at the rear of the module, both chassis covers can be lifted. When reclosing the module, care should be taken that the guides engage correctly with the front chassis.

Operation of the module

Provided that all hints given in the operating instructions of the HM8001-2 Mainframe were followed especially for the selection of the correct mains voltage start of operation consists practically of inserting the module into the right or left opening of the mainframe. The following precautions should be observed:

Before exchanging the module, the mainframe must be switched off. A small circle (o) is now revealed on the red power button in the front centre of the mainframe.

If the BNC sockets at the rear panel of the HM8001-2 unit were in use before, the BNC cables should be disconnected from the basic unit for safety reasons. Slide in the new module until the end position is reached.

Before being locked in place, the cabinet of the instrument is not connected to the protective earth terminal (banana plug above the mainframe multipoint connector). In this case, no test signal must be applied to the input terminals of the module.

Generally, the HM8001-2 set must be turned on and in full operating condition, before applying any test signal. If a failure of the measuring equipment is detected, no further measurements should be performed. Before switching off the unit or exchanging a module, the instrument must be disconnected from the test circuit.

Control-Elements

① **DISPLAY** (7-segment LED + LED)
The digital display shows the measurement value with 4¾ digit resolution, in which the largest figure is used up to "5". It will also display various warning messages. The measurement value will be displayed with decimal points and polarity sign. For DC measurement, a minus sign will appear in front of the figures when the positive polarity of the measured value is connected to the COM input ⑦.

② **(LED)**
Indicator denoting validation of the audible continuity test signal. When used as an ohmmeter, the audible signal triggers when the measured resistance value is less than 0.1% of the range or 50 counts. For other functions, the indicator is hidden.

③ **BEEP** (pushbutton)
Pushbutton for activating the audible signal.

④ **A** (safety terminal for 4 mm banana plugs)
Connection (high potential) for DC and AC current measurements in the 10 A range in conjunction with the COM input ⑦ (low potential).

Current in excess of 10 A (max. 20 A) must not be applied for a period exceeding 30 s, otherwise the internal measurement resistor thermal device will blow.

⑤ **mA** (safety terminal for 4 mm banana plugs)
Connection (high potential) for DC and AC current measurements up to 500 mA in conjunction with COM input ⑦ (low potential). The input is fuse-protected.

⑥ **HOLD** (LED)
Indicator denoting that the displayed value has been frozen. The function can be activated using key ⑩. Deactivation is by pressing the HOLD/OFFSET key.

⑦ **COM** (safety terminal for 4 mm bana plugs)
The COM terminal (low potential) is the common connector for all the measurement functions to which the potential close to the ground of the measured quantity will be applied.

For safety reasons, the voltage across this terminal compared to the case (guard wire, ground) shall be 250 V at most.

⑧ **OFFSET** (LED)
Indicator denoting that the displayed value is a relative measurement. The displayed value corresponds to the input value less the value present

on the display during initial action on the HOLD/OFFSET key ⑩. Activate this function by means of a second press on the HOLD/OFFSET key.

⑨ **V/Ω/T°/dB/⊣◄**
(safety terminal for 4 mm banana plugs)
Connection (high potential) for measurements of voltages, resistances, temperatures and diode junctions in conjunction with the COM input ⑦ (safety terminal).

For safety reasons, the voltage across this terminal compared to the case (guard wire, ground) shall be 600 V_{DC} at most.

⑩ **HOLD/OFFSET** (pushbutton)
Pushbutton for validating the HOLD or OFFSET functions. Pressing the key the first time will freeze the front panel display. The HOLD indicator ⑥ then comes on. The AUTO, AC-DC, BEEP, ◄⑪ and ►⑫ keys are inoperative.

A second press gives access to the relative mode. The value memorized by the HOLD function is then subtracted from each measurement before being displayed. The OFFSET indicator ⑧ comes on.

A third press will freeze the relative value. The HOLD ⑥ and OFFSET ⑧ indicators come on. A fourth press will delete the HOLD and OFFSET mode.

⑪ ◄ (pushbutton)
Pushbutton for changing to lower range. On each press, the new range is displayed fleetingly on the display in code form (L1 for lowest range, L2 for second range, etc.).

⑫ ► (pushbutton)
Pushbutton for changing to higher range. Each time pressed, the new range will be displayed fleetingly on the display in code form (L1 for lowest range, L2 for second range, etc.).

⑬ **RS-232** (DB9)
Female DB9 connector intended for serial communication.

⑭ **AUTO (LED)**
Indicator signalling that the multimeter is in AUTOMATIC mode. In this mode, action on keys ◄⑪ and ►⑫ is inoperative.

⑮ **AUTO** (pushbutton)
Pushbutton for switching the AUTO range selection to the MANUAL range selection and vice versa.
In MANUAL mode, the choice of range is left to user initiative using the keys ◄⑪ and ►⑫.

⑯ **Unit display zone** (LED)
This zone contains a display of the measurement units. It also identifies the function selected by pressing the ▼⑱ or ▲⑲ key.

⑰ **AC-DC** (pushbutton)
This key is used for selecting the measurement mode (DC, rms AC or rms AC + DC).
Indicators below indicate the measurement mode:
DC: measurement of DC voltages
AC: measurement of RMS AC voltages
DC + AC: measurement of RMS AC+DC voltages.

⑱ ▼ (pushbutton)
Pushbutton for selecting the next function.

⑲ ▲ (pushbutton)
Pushbutton for selecting the previous function. On startup, the unit switches automatically to the DC voltmeter, MANUAL mode function and 600 voltrange.

Functions

Beginning in volt range (V) by using the keys ▼⑱ and ▲⑲ you can step through all the multimeter functions one by one, in following order:

- DC or AC voltages. Input on the V/Ω/T°/dB and COM connectors.
- The measurement of DC or AC voltages in decibels (reference 1 mW/600Ω). Input to V/Ω/T°/dB and COM connectors.
- DC or AC current up to 500 mA. Inputs on mA and COM connectors.
- DC or AC current, 10 A range. Inputs on the A and COM connectors.
- Resistors. Inputs V/Ω/T°/dB and COM connectors.
- Temperature in degrees Celsius. Connection of probe to V/Ω/T°/dB and COM connectors.
- Temperature in degrees Fahrenheit. Connection of probe to V/Ω/T°/dB and COM connectors.
- Diode test. Inputs on V/Ω/T°/dB and COM connectors.

On each press, the new function is indicated by a LED corresponding to the unit of the quantity to be measured. It is possible to move from one function directly to any other function by a successive series of pressings.

Mode selection

For current and voltage modes, the AC-DC key ⑰ is used for choosing between DC voltage measurement, AC or AC + DC true rms voltage measurement.

Range selection

In manual mode, ▼⑱ and ▲⑲ keys are used for switching between the various measurement ranges. The measurement ranges are split into decades. After each range change, a code appears indicating the new range being used. This code is in LX form, where X is a value that may vary from 1 to 6 depending on the range and function and L1 is the lowest range. During measurements of unknown voltages or currents, first choose the highest measurement range, then switch to the range giving the most favorable display.

Change to the higher range is obtained when the value exceeds 51,000 counts. Change to the lower range is obtained when the value drops below 4,900 counts. It is possible to know which range has been selected by the unit by temporarily deactivating the AUTO mode so that the range indication code appears fleetingly.

Measurement value display

Measurement values are represented by 7 segment LED's display associated with one LED for the negative sign. The maximum value of the 1st digit is 5; this corresponds to a 4¾ digit display with a 50,000 counts measurement capacity. A minus sign appears in front of the figures when, during DC measurements, the positive polarity of the measured value is on the COM terminal ⑦. With the inputs short-circuited, the display indicates (depending on the measurement range) value zero ±2 digit. When the range is overrun, the display shows "OFL" and an audible beep is emitted repeatedly if it is selected. For the resistance measurement function, the exceeding of the capacity (>50 MΩ) generates the "OPEN" message.
If the multimeter is not connected to a circuit, the display indicates random values due to the very high input impedance for ranges of 500 mV and 5V.

Measurement inputs

The HM8012 has four safety terminals with which, when using appropriate measurement cables (e.g. HZ15), unintended contacts with the measurand are nearly impossible. As a safety measure the measurement cables should be checked periodically for insulation faults and, when necessary, be replaced. The "COM" terminal ⑦ is common to all the measurement ranges. The potential close to ground of all the measurement quantities should be applied to this terminal. The input mA ⑤ and A ④ is intended only for current measurements, whereas the input V/Ω/T°/dB ⑨ is designed for all other measurements. Each terminal is appropriate to receive 4 mm banana plugs.

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Voltage measurements

The maximum input voltage of HM8012 is 600 V_{DC} when the COM terminal is to ground potential, i.e. by connecting HM8012 to the object to be measured, the sum of the measurement voltage and that of the COM terminal with respect to ground shall not exceed 600 V_{DC}. In this case, the maximum voltage value between the COM terminal and ground is 250 V_{DC}.

For AC voltages, the true rms value of the input voltage will be measured, and the DC component eliminated in AC mode. If possible, the COM terminal ⑦ shall be connected directly to ground or to the point of the measurement circuit having the lowest potential. The 0.5 V and 5 V voltage measurement ranges are protected from input voltages to 300 V_{rms}; all the other ranges are protected to 850 V_{rms}.

During measurements on circuits using inductive components, inadmissible high voltages may appear when the circuit is opened. In such cases, take steps to prevent the destruction of HM8012 by inductive voltages.

Input impedance in the DC range

To make the most of the excellent linearity of the measurement system, the input impedance for voltage measurements is very high (1 GΩ) for some ranges. For instance, this makes possible to perform accurate measurements on ranges of up to ±5V, even when the internal impedance of the source to be measured is high. For instance, for the 500 mV range, an internal 5 MΩ source resistance will induce a maximum error of 150 µV.

Indeed, switching to the 50 V range will cause the input voltage to drop because of the input impedance of 10 MΩ which can cause the multimeter to switch to the lower range and so on. After some swings, the instrument goes into MANUAL mode.

Current measurement

For current measurements, the connection of the object to be measured is made across the mA ⑤ terminal or to the A ④ terminal for currents of up to 10 A. The AUTO mode is inhibited because there is only one range.

The HM8012 should be connected to the circuit whose potential with respect to ground is lowest. For safety reasons, the COM terminal ⑦ must not exceed 250 V_{DC} with respect to ground.

Current ranges are protected by fuse against overloads. If the fuse blows, the cause of the overload must be eliminated. In case of an open fuse the instrument has to be sent in for repair. A change of the fuse by the customer is not permitted.

AC voltage measurement

The instrument measures the true rms value of the input voltage with or without its DC component. To measure low voltages, or in the event of high noise, it is necessary to use a shielded cable.
Take into account the input impedance of the multimeter. It is 1 MΩ in the AC mode and 10 MΩ in the AC + DC mode. In addition, there is a slight measurement difference between these two modes due to the input circuits. If AC measurements without a DC component are to be made, it is preferable to use the straight AC mode.
When the multimeter is used in AUTOMATIC mode, there can be continuous swinging between two ranges for frequencies above 30 kHz, because of the frequency response difference of the two ranges. After some swings, the instrument goes into MANUAL mode.
Measuring errors can be caused by an overload of the measuring amplifiers and the A/D converter. For measurements of mixing tensions (positive or negative DC voltage overlaid with an alternating voltage) select a measuring range which is not exceeded by the peak value of the alternating voltage – the largest deviation from the reference potential (normally 0 V). That applies also, if only the DC voltage portion is to be measured.

A DC voltage of 350 mV is superimposed with a sine signal with an amplitude of 200 mV_p (400 mV_{pp}). The highest deviation from 0 V amounts 550 mV_p (350 mV_p + 200 mV_p). For DC and AC+DC measurements the 5 V-range must be selected. AC measurements can be done in the 500 mV range, because then a capacitor in the entrance suppresses the DC voltage. It is reasonable, first to determine the height of the possibly existing alternating voltage with AC measurement. Then switch to DC or AC+DC function and consider the

alternating voltage height with the measuring range choice.

Resistance measurements

For resistance measurements, connect the object to be measured between the COM terminal ⑦ and the V/Ω/T°/dB terminal ⑨. There is a DC voltage across the connection terminals. Accordingly, only voltage-free objects need to be measured because the voltages in the measurement circuit will distort the result. In the case of low resistance measurements, the OFFSET key ⑧ can be used to compensate, where applicable, for measurement cord resistance.
For high resistance measurements, it is advisable to place the resistance to be measured as close as possible to the measurement terminal or to use a shielded measurement cable connected to ground.

Protection against overloads

All the HM8012 measurement ranges are protected against various forms of overload. Precise indications are given in the technical characteristics.

In general: during the measurement of unknown quantities, always begin with the highest measurement range and, from then on, switch ranges using optimum display. If HM8012 malfunctions, first eradicate the cause before going on to make the following measurement.

Crest factor

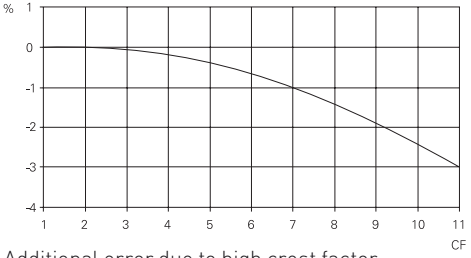
To evaluate complex or deformed signals, the determination of a true rms value is necessary. The HM8012 digital multimeter will allow the measurement of AC quantities with a display of the true AC or AC + DC value. The crest factor is important data for interpreting measurement values and for evaluating its accuracy. It is defined as the ratio between the peak voltage and the rms value of the signal.

$$\text{Crest factor} = CF = V_p/V_{RMS}$$

It is a measurement of the dynamic input voltage range of the AC converter and expresses the capability of processing measurement signals with a high peak value, without the converter entering into saturation.

The HM8012 crest factor ranges from 1 to 7 (for additional measurement error of <1%) and depends on the magnitude of the rms value of the signal to be measured.

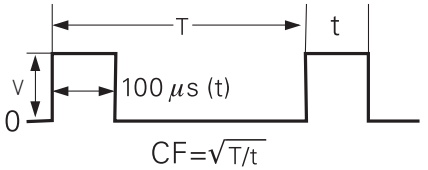
To avoid saturation of the HM8012 input stages, make sure that the input signal peak value does not exceed 3 times the value of the range, or 850 V_p. At the middle of the measurement range, the maximum crest factor is 7. The accuracy of the displayed value depends, among other things, on the rms value converter bandwidth. Complex signal measurements will barely be influenced when there are no harmonic components in the measurement signal placed outside the 100 kHz (–3 dB) bandwidth of the converter.



Additional error due to high crest factor
Error ± (% of reading)

CF	1-2	2-3	3-4	4-5	5-6
%	0.05	0.15	0.3	0.4	0.5

Another factor influencing the measurement precision is the duty cycle of the measurement signal. The crest factor in this relation becomes:



T = period duration, t = pulse duration
V = pulse voltage.

Accordingly, a rectangular signal having a duty cycle of 1% has a crest factor of 10. The minimum pulse duration should be approximately 10 µs.

Diode test

Choose the diode test function ⊣◀ using ▼⑱ or ▲⑲ key. For diode measurements, connect the device under test (DUT) between the COM terminal ⑦ and the V/Ω/T°/dB ⑨ terminal. There is

a DC voltage across the connection terminals. Accordingly, only voltage-free objects need to be measured because any additional voltages in the measurement path will distort the result. It is preferable to remove, if necessary, any components connected to the semiconductor for precise results. It is possible to measure voltages up to 5 V. The maximum voltage that the equipment will supply is 10 V in an open circuit. If the cathode of the DUT is connected to the ground (COM-terminal), the diode operates in its conducting mode. If the anode of the DUT is connected to ground, the diode operates in its reverse mode. For measurements on Zenerdiodes, the anode of the device should be connected to ground. Take care when making measurements on sensitive circuits. The current supplied by HM8012 is 1 mA constant for this function. All keys except ▼⑱, ▲⑲ and HOLD/OFFSET ⑩ are inactive for this function.

Temperature measurements

Choose the temperature measurement function (°C or °F) using ▼⑱, ▲⑲ key. The temperature probe is connected between the COM terminal ⑦ and the V/Ω/T°/dB terminal ⑨.

Temperature measurement requires a temperature probe type PT100 as per standard EN60751. The use of another probe is possible but can generate additional errors due to a different link cable resistance. All keys except ▼⑱, ▲⑲ and HOLD/OFFSET ⑩ are inactive for this function.

After the instrument has been turned-on, the line resistance value of the temperature probe is automatically compensated.

On starting, simultaneously pressing BEEP ③ and OFFSET ⑩ will eliminate probe cable resistance compensation (zero value). In all cases, compensation can be carried out by setting the probe to a temperature of 0 °C and using the OFFSET function.

Note: Measurement of the temperature probe line resistance should be made on the same instrument used for temperature measurements. Only this procedure guarantees the specified measurement error.

Decibel measurements

Choose the decibel measurement function using ▼⑱, ▲⑲ key. For decibel measurements, the unknown input voltage is connected between the COM terminal ⑦ and the V/Ω/T°/dB terminal.

The HM8012 is used for DC or AC voltage measurements in decibels. The 0 dB reference is defined for 1 mW power in a 600Ω load., i.e. a voltage of 0.7746 V. The scale extends from –78 dBm to 59.8 dBm.

In a 50Ω-system, the reference voltage for 1mW power is 0.2236 V. In a 75Ω-system, the reference voltage for 1 mW power is 0.2739 V.

If decibel measurements are made on a 50Ω-system, add 10.8 dB to the displayed value. If decibel measurements are made on a 75Ω-system, add 9 dB to the displayed value. The mathematical relationship is as follows:

$$V_0 = \sqrt{R \cdot P_0} \cdot 10^{\frac{dB}{20}} \Rightarrow dB = 20\log\frac{V_0}{\sqrt{R \cdot P_0}}$$

R= Reference resistance in Ω; P_0 = 1 mW; V_0 in V

Sign consideration: A displayed value of –12 dB is equivalent in 50Ω to: –12 dB +10.8 dB = –1.2 dB

Remote control

HM8012 includes a front panel connector ⑬ for controlling the equipment by means of a point-to-point serial link. There are 3 wires used: RxD (Receive Data), TxD (Transmit data), SGnd (Signal Ground). The signal voltage levels must comply with the following levels (±15 V max., ±3 V min.).
The link is of the bi-directional asynchronous type with a fixed configuration: 4800 Baud, 8 bits, no parity, one stop bit. The synchronization protocol is XON/XOFF (half duplex) and is also fixed.
Each control must have two ASCII code characters followed by character 13 (symbolized as <CR> in ASCII) or two characters 13 and 10 (symbolized as <CR> <LF> in ASCII), while the <LF> character is ignored during reception.
The instrument internal buffer includes only three characters, and there is no way of sending

more than one command at a time. On reception of terminator <CR>, the equipment sends the character 19 (<DC3> ASCII) to indicate that the dialogue is suspended. As soon as it is possible to resume dialogue, the instrument sends character 17 (<DC1> ASCII). The commands are divided into five groups:

Function commands

These commands are used for choosing another magnitude to be measured and corresponding to the choice of FUNCTION key on the front panel.

VO<CR> voltage measurement (VOLT)
AM<CR> current measurement (A)
MA<CR> current measurement (mA)
OH<CR> resistance measurement
DI<CR> diode test
TC<CR> temperature measurement in °C
TF<CR> temperature measurement in °F
DB<CR> measurement in dB.

For these commands, there is no error recovery provided for because it is normally possible to put the instrument in one of these states at any time.

Mode commands

Mode commands correspond to the "MODE" key on the front panel.

DC<CR> switches the instrument to the DC measuring mode.
AC<CR> switches the instrument to the AC measuring mode.
AD<CR> switches the instrument to the AC + DC measuring mode.
BY<CR> activates the continuity test beep.
BN<CR> deactivates the continuity test beep.

If the requested mode is not compatible with the current function (e.g.: sending the AC command while the instrument is measuring resistances), the instrument will indicate this by a beep in the same way as for the front panel control. In addition, the control error indicator is set (see command E?).

Range modification commands

These correspond to the "RANGE" keys on the front panel.

AY<CR> switches to automatic range change
AN<CR> switches to manual range change
R+ <CR> switches to the next higher range
R– <CR> switches to the next lower range.

If it is impossible to activate or deactivate the autoranging the current function (e.g. following the AM command to switch to current measurement the AY command cannot be executed since the measurement is made in a single range for this function) or if it is impossible to change ranges, the instrument will send a beep. In addition, the command error indicator is then set (see command E?).

Display type commands

These correspond to the choice of the HOLD OFFSET key on the front panel.

HD<CR> switches the instrument to HOLD
O1 <CR> switches the instrument to OFFSET (Single)
O0<CR> switches the instrument to NORMAL
L0<CR> locks the front panel. In this case, pressing a front panel key will cause the "rtEOn" message to appear.
L1<CR> is a way of unlocking the front panel.

The NORMAL type corresponds to a display without a reference (OFFSET) and without maintaining (HOLD) the front panel state. In the same way as for the manual control, it is impossible to switch to the OFFSET mode without first going to the HOLD mode. Indeed, the maintained measurement is used as a reference.

The possible steps are therefore:
NORMAL (HD) → HOLD (O1) → OFFSET (HD) → OFFSET + HOLD (O0) → NORMAL

Unlike the manual command, it is possible to return directly to the NORMAL mode at any time during command O0.

Status commands

The status commands are used for recovering the status of the instrument. The returned information consists of ASCII character strings, each terminating in a <CR>.

I? <CR> Request for equipment identification which returns:
HAMEG, HM8012, V1.03<CR>
I.e.: manufacturer, instrument

reference, void and software version (Firmware).

F? <CR> Requests current measurement function. The instrument returns one of the following strings:
VOLT<CR>
AMP<CR>
MAMP<CR>
OHM<CR>
DIODE<CR>
TDGC<CR>
TDGF<CR>
DB<CR>

M? <CR> Requests current measurement mode. The instrument returns one the eight following strings:
AC BEEP-ON <CR>
AC BEEP-OFF <CR>
DC BEEP-ON <CR>
DC BEEP-OFF<CR>
AC+DC BEEP-ON <CR>
AC+DC BEEP OFF <CR>
BEEP ON <CR>
BEEP OFF <CR>
The first six answers are obtained in voltage and current functions, the last ones in the others.

D? <CR> Request for current display option. The instrument sends back one of the strings:
HOLD<CR>
REF<CR>
HOLD+REF<CR>
NORMAL<CR>
The REF string corresponds to the front panel OFFSET mode. The NORMAL string indicates that the display is neither on HOLD nor on REF.

R? <CR> Requests for current measurement range. The instrument returns one of the following strings:
NUM<CR>
NUM AUTO<CR>
The first NUM field represents a digital character indicating the current range number. Where applicable, a second field is displayed indicating that the automatic range change mode is active. Note that the range numbers correspond respectively to:
(1 - > 0.5 V, 0.5kΩ, 500 µA, T°C, T°F)
(2 - > 5 V, 5 kΩ, 5 mA, Diode)
(3 - > 50 V, 50 kΩ, 50 mA)
(4 - > 500 V, 500 kΩ, 500 mA)
(5 - > 1000 V, 5 MΩ)
(6 - > 50 MΩ, 10 A)

P? <CR> This command alone is used for recovering complete parameter settings of the equipment.
The instrument returns:

string_F, string_M, string_R, string_D <CR>
string_F is one of the responses returned by command F?
string_M is one of the responses returned by command M?
string_R is one of the responses returned by command R?
string_D is one of the responses returned by command D?

S? <CR> Request to send current measurement. The instrument returns a string in the shape:
NUM UNIT <CR>
NUM represents the digital value field in IEEE NR2 format (in our case, five significant digits at most with the presence of a decimal point). The significant digits are those of the front panel display.
UNIT is the field giving, as suggested by the name, the unit or a submultiple thereof. The possible values are identical to that of the front panel.

E? <CR> Request for status of command error indicator. The instrument returns:
0<CR> if the command or commands received previously have not generated an error,1<CR> if one of the com-mands received previously has generated an error.
The use of this command resets the error indicator to 0. Indeed, in the event of an error, as long as the user has not requested the status of the indicator through this command, the latter will remain set even if other commands go through without errors.

Function Test

This test should help verify, at certain intervals, the functions of HM8012 without any great expenditure in measurement instruments. To achieve thermal balance, the module and the basic instrument, in its case, must be energized for at least 60 minutes before the test begins.

Measurement equipment used

Calibrator AC/DC for instance Fluke 5101B / Fluke 5700A / Rotek 600
Resistors of 5 kΩ, 50 kΩ, 500 kΩ 0.01% for instance model S102 J by Vishay
Resistors 500 kΩ, 5 MΩ 0.02%, for instance models CNS020 by Vishay.

Test procedure

If one of the indicated calibrators is available or if precision calibrators are appropriate, all the HM8012 measurements ranges can be checked using the following tables which indicate the limit values. Recalibration, however, should only be performed if the appropriate precision calibrator is available.
Before any change of ranges, ensure that the signal at HM8012 does not represent an unacceptable load of the object under examination. For the link between the calibrator and HM8012, shielded cables must be used to prevent any unwanted influence caused by the measurement signal.

a) DC voltage ranges

No.	Range	Reference (+23 °C)	Display limits
1	500 mV	250 mV	249.85 - 250.15
2	5 V	2.5 V	2.4986 - 2.5014
3	50 V	25. V	24.985 - 25.015
4	500 V	250 V	249.86 - 250.14
5	600 V	550.00 V	549.7 - 550.3

b) AC voltage ranges

No.	Range	Reference (+23 °C)	Display limits
1	500 mV	250 mV	(1) 248.65 - 251.35 (2) 247.15 - 252.85
2	5 V	2.5 V	(1) 2.4865 - 2.5135 (2) 2,4715 - 2.5285
3	50 V	25 V	(1) 24.865 - 25.135 (2) 24.715 - 25.285
4	500 V	250 V	(3) 248.65 - 251.35 (4) 247.15 - 252.85
5	600 V	550 V	(3) 547.3 - 552.6 (4) 544.0 - 555.9

(1) = 40 Hz to 5 kHz
(2) = 20 Hz to 20 kHz
(3) = 40 Hz to 1 kHz
(4) = 20 Hz to 1 kHz.

c) DC current ranges

No.	Range	Reference (+23 °C)	Display limits
1	500 µA	250.00 µA	249.48 - 250.52
2	5 mA	2.5000 mA	2.4948 - 2.5052
3	50 mA	25.000 mA	24.948 - 25.052
4	500 mA	250.00 mA	249.48 - 250.52
5	10 A	1.800 A	1.794 - 1.806

d) AC current ranges (f = 400 Hz)

No.	Range	Reference (+23 °C)	Display limits
1	500 µA	250.00 µA	247.9 - 252.1
2	5 mA	2.5000 mA	2.479 - 2.521
3	50 mA	25.000 mA	24.79 - 25.21
4	500 mA	250.00 mA	247.9 - 252.1
5	10 A	1.800 A	1.775 - 1.825

e) Resistor ranges

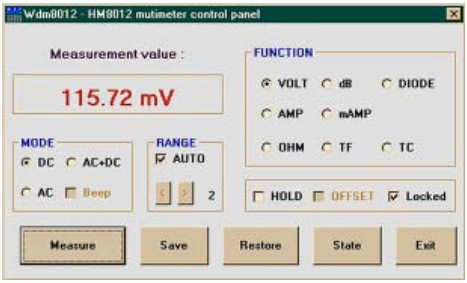
No.	Range	Reference (+23 °C)	Display limits
1	500 Ω	200.00 Ω	199.83 - 200.17
2	5 kΩ	2.0000 kΩ	1.9989 - 2.0011
3	50 kΩ	20.000 kΩ	19.989 - 20.011
4	500 kΩ	200.00 kΩ	199.89 - 200.11
5	5 MΩ	2.0000 MΩ	1.9939 - 2.0061
6	50 MΩ	20.000 MΩ	19.393 - 20.061

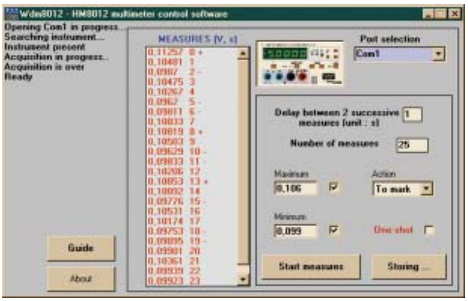
WDM8012 SOFTWARE

A CD-ROM is provided with the HM8012 multimeter, including the user manual, the WDM8012 software running under Windows®, as well as an application software running under Excel®.

All instrument functions can be controlled by a host computer through serial interface available in standard.

The WDM8012 software is a virtual instrument allowing the command of the instrument and the reading of its configuration. This one can be saved and recalled later.

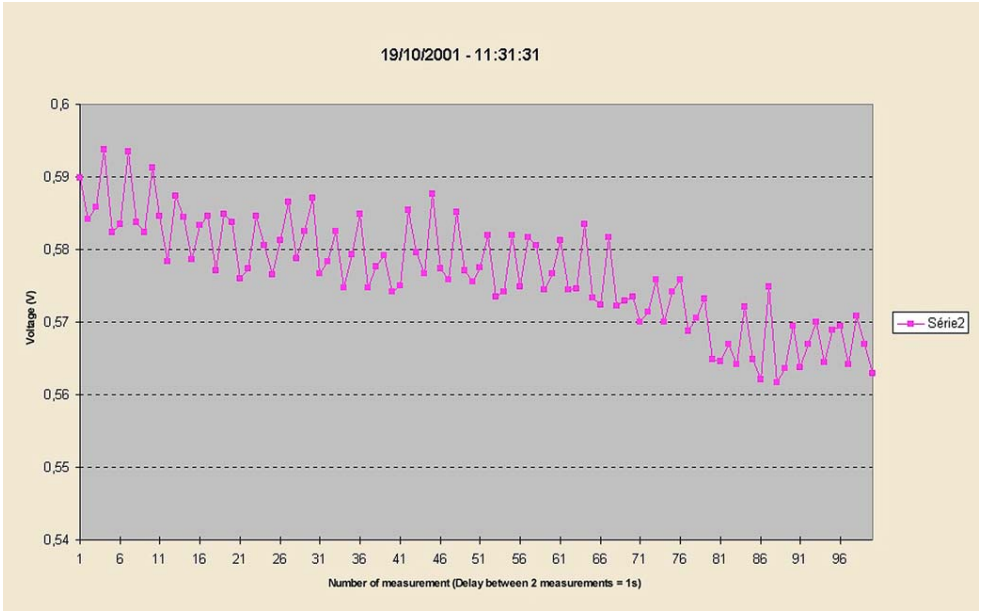




When the configuration of the instrument is done, a set of measurements can be carried out and saved for future use.

Furthermore, the software can show deviations of the values relative to two predetermined thresholds. A DDE link is also possible, which make easier the integration of the instrument in specific application software.

A software running under Excel® allows automatic drawings of curves, with a programmable delay between successive measurement ranging from 1s to 65 s.



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